D3

(12) UK Patent Application (19) GB (11) 2 002 660 A

(21) Application No: 7830468
(22) Date of filing:
20 JUL 1978
(23) Claims filed:
20 JUL 1978
(30) Priority data:
(31) 2732677
(32) 20 JUL 1977
(31) 2831140
(32) 15 JUL 1978
(33) FED. REP. OF GERMANY (DE)
(43) Application published:
28 FEB 1979
(51) INT. CL.²: B23B 31/20
(52) Domestic classification:
B3B 2A1 2G2 2P1 2Y4
(56) Documents cited:
GB 1360614
GB 1267690
GB 751893
GB 656175
GB 584258
(58) Field of search:
B3B
(71) Applicants:
WILHELM HAINBUCH GmbH u.CO., PRAZISIONSSPANN-WERKZEUGFABRIK, 7142 MARBACH, ERDMANNHAUSER STRASSE 57, GERMANY
(72) Inventors:
GERHARD RALL, HERMANN KASTNER
(74) Agents:
MARKS & CLERK

(54) 2-PART COLLET CHUCK

(57) A collet chuck is formed with a collet chuck or nose part 21 releasably coupled to a collet tube part 22 which is threaded. The collet chuck part provides a ring of jaws having their flank surfaces joined to one another by resilient means e.g. a layer of elastomeric material. A compression force applied to an external frusto-conical surface 25 of the chuck part causes the jaws to be compressed independently inwards so that they can grip a workpiece located between them. The coupling device 23 provides abutting torque-transmitting surfaces on interdigitating axial projections on the two parts, the projections defining also a channel in which a retaining or coupling ring 43 is accommodated to prevent separation of the two parts when in use. Disconnection of the coupling is achieved either by removing the ring or by increasing the angle of the jaws to the chuck part axis which causes the chuck part projections to disengage from behind the coupling ring. A change-over device which can be applied to the chuck part when it is to be replaced, is operable to vary the jaws angles simultaneously. The design of the collet chuck in two disconnectable parts reduces the overall cost and size of a set of collet chuck on a lathe as the tube part does not have to be removed with the chuck part.

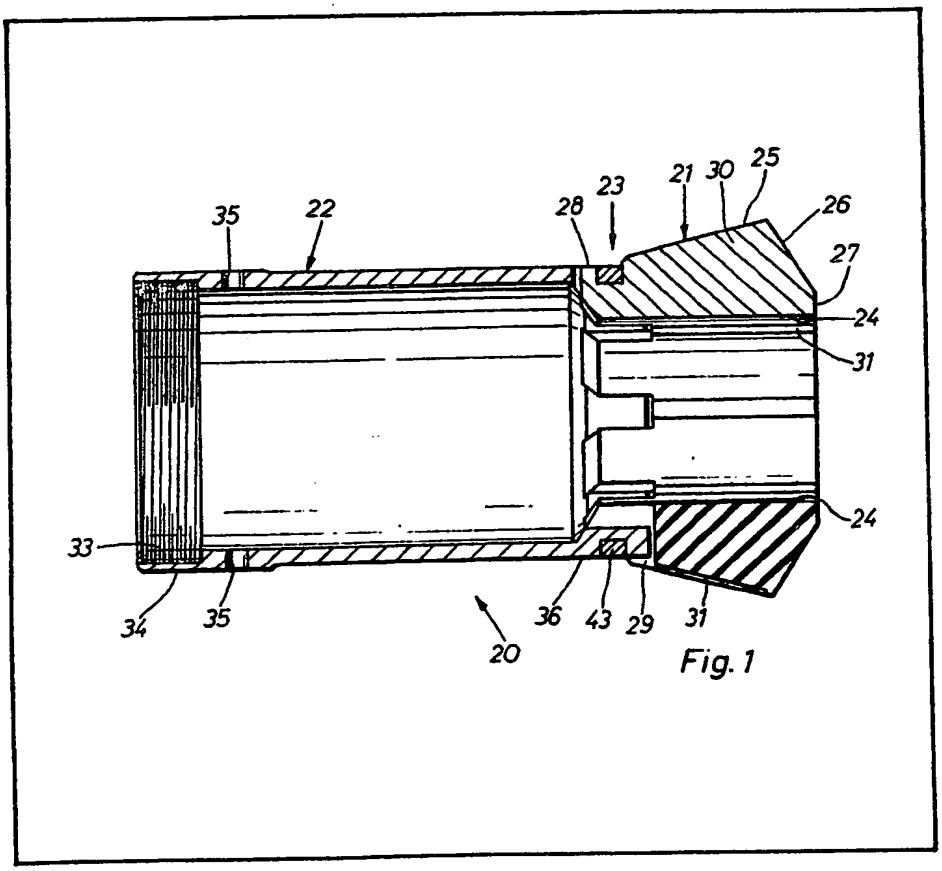


Fig. 1

GB 2 002 660 A

2002660

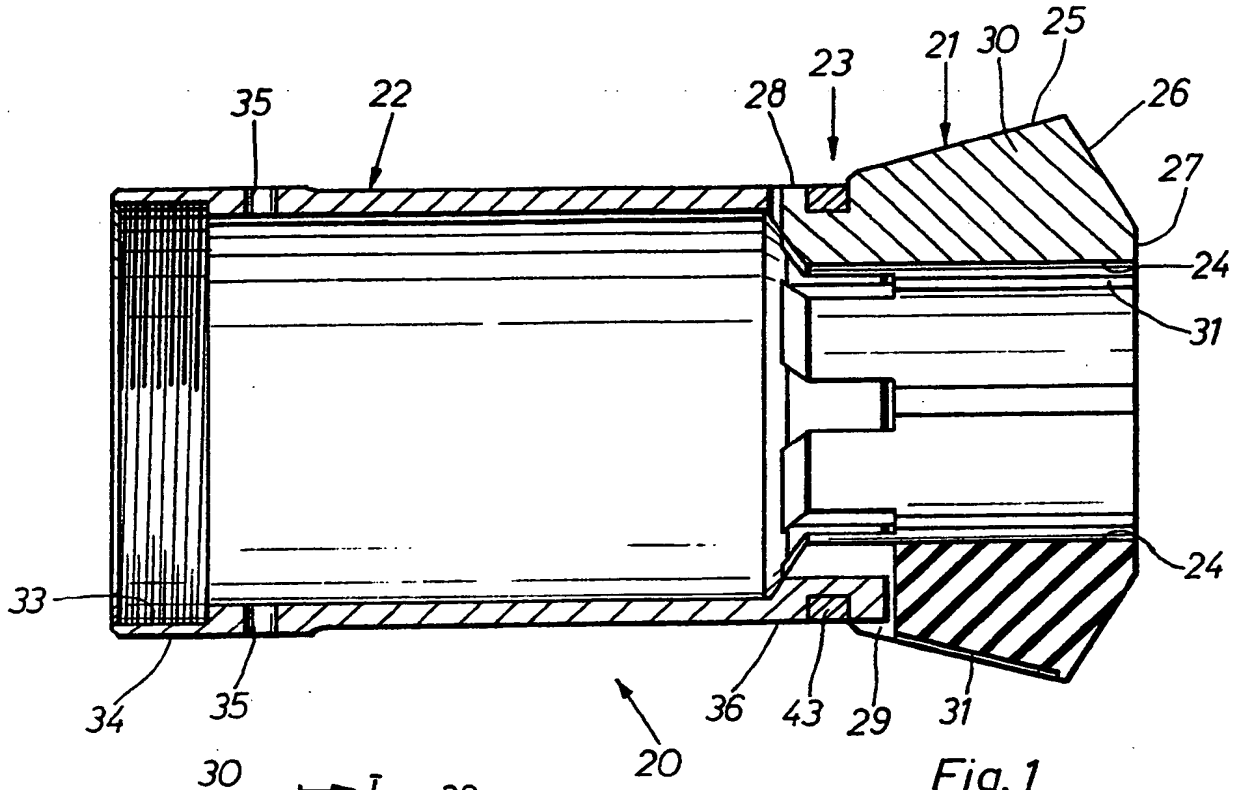


Fig. 1

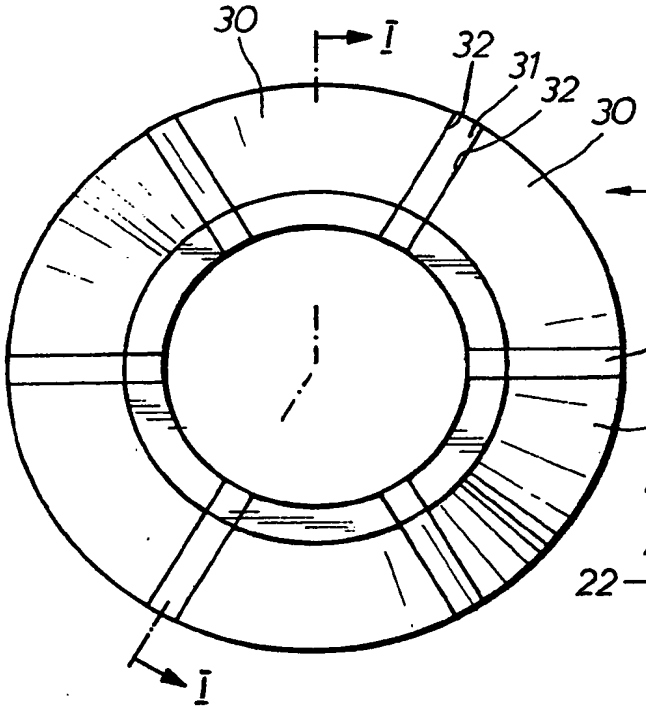


Fig. 2

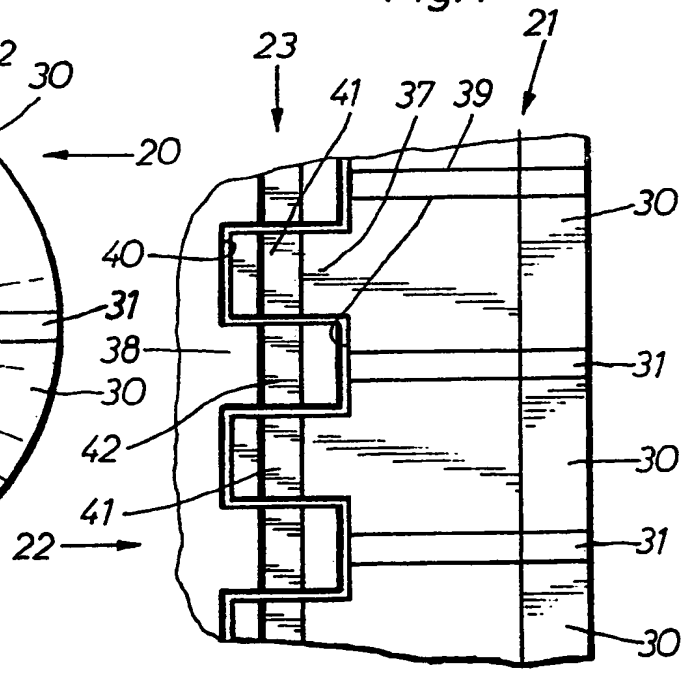


Fig. 3

2002660

Fig. 4

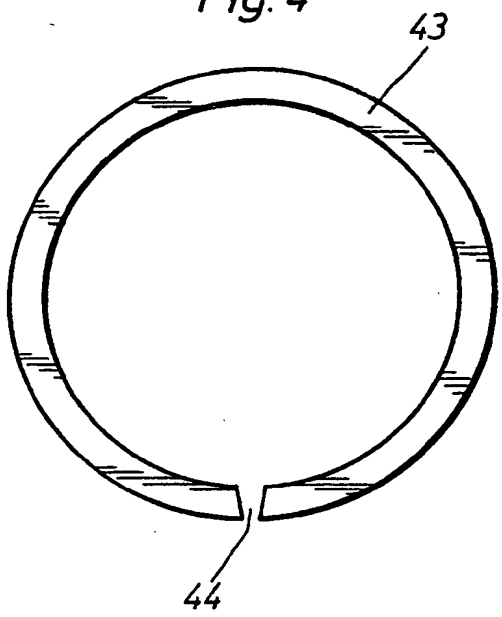
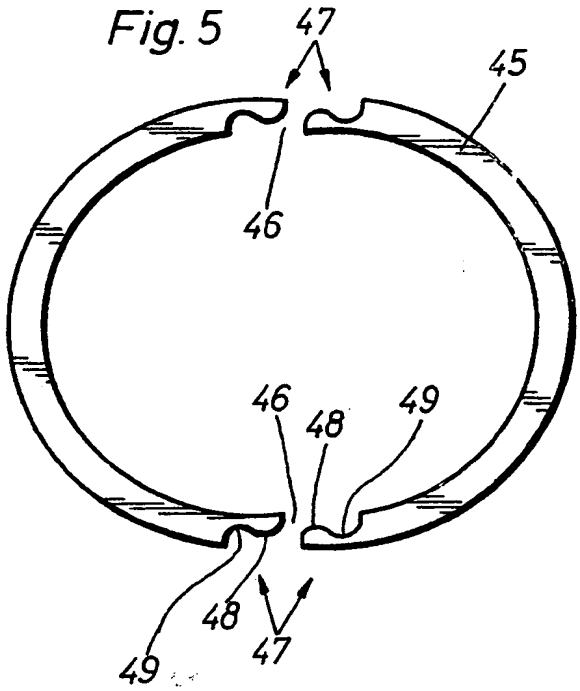


Fig. 5



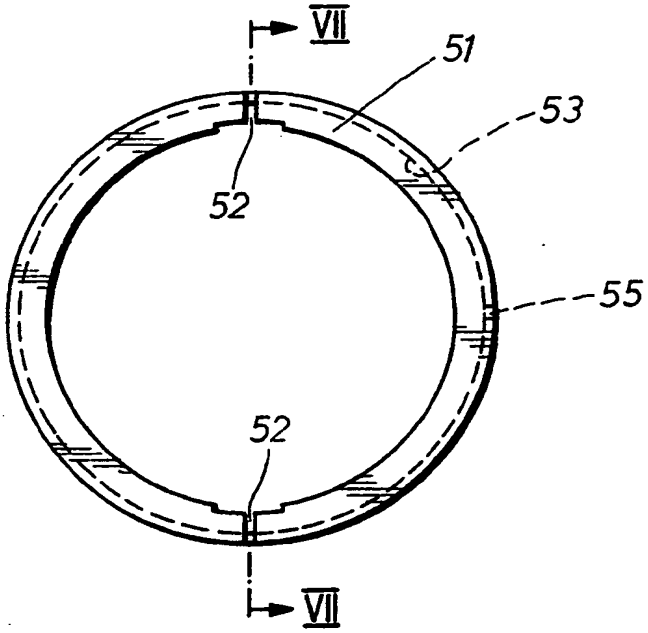


Fig. 6

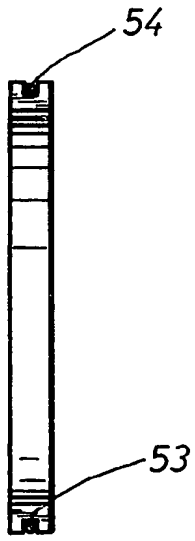


Fig. 7

2002660

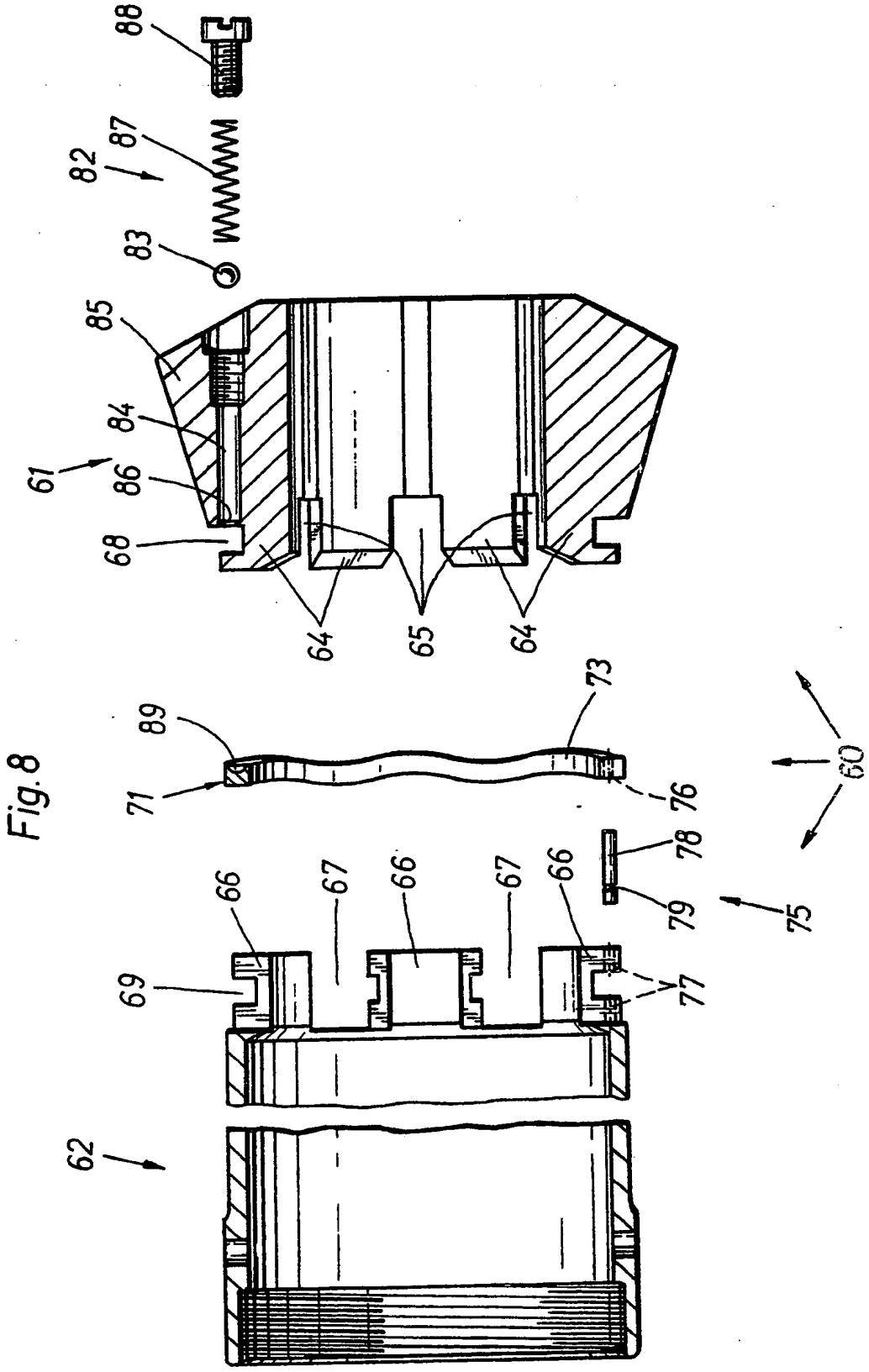
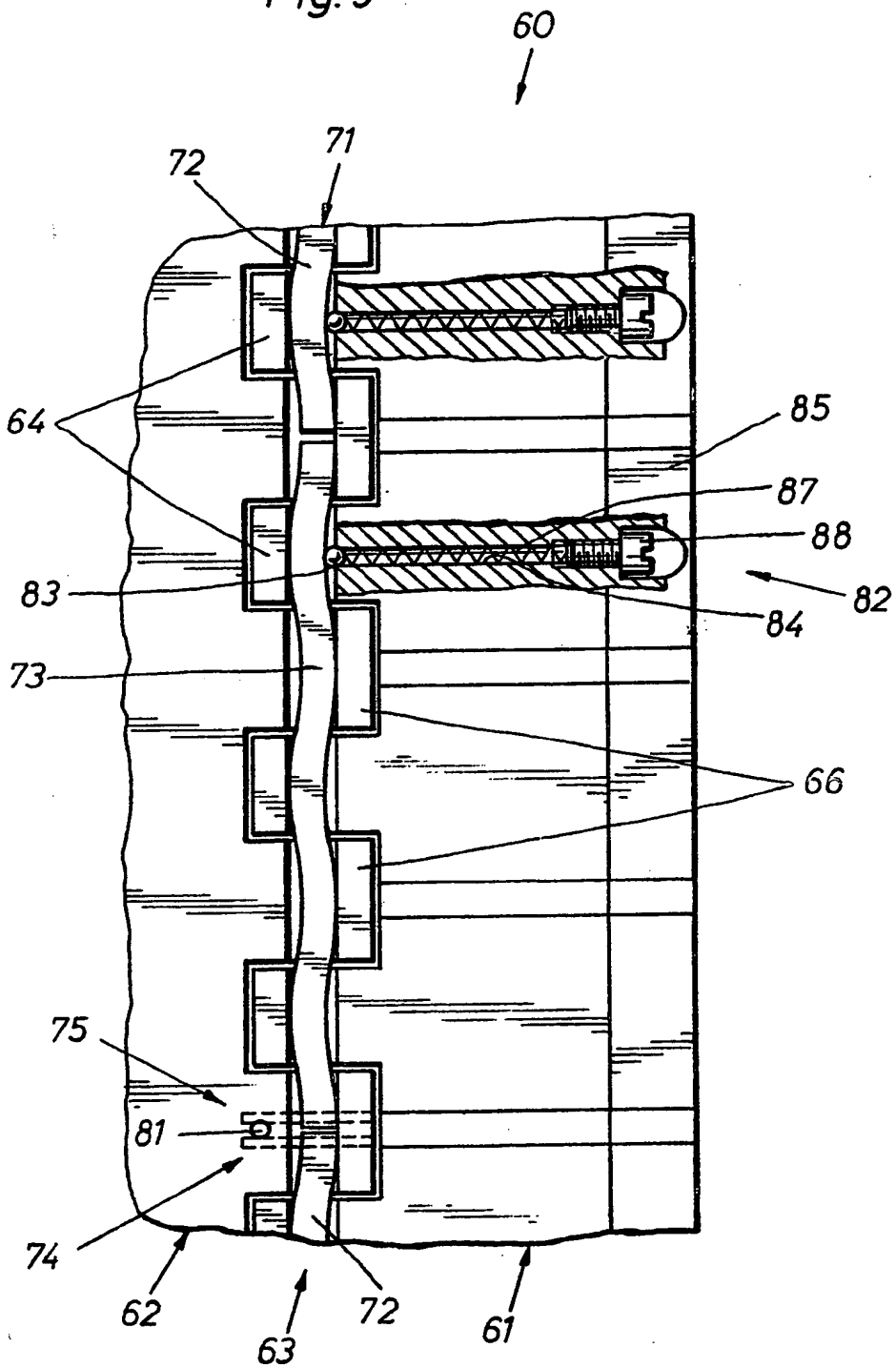


Fig.8

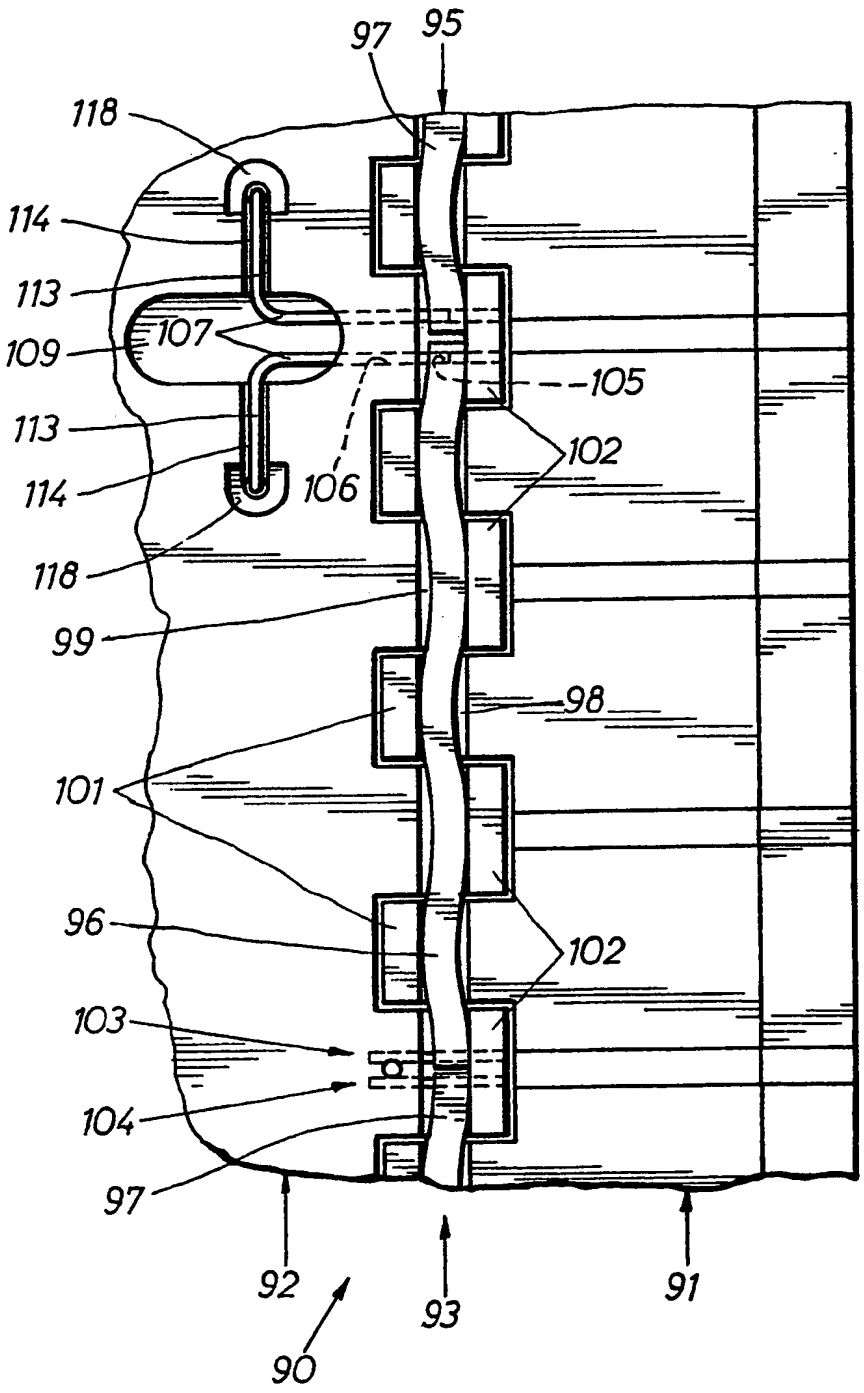
2002660

Fig. 9



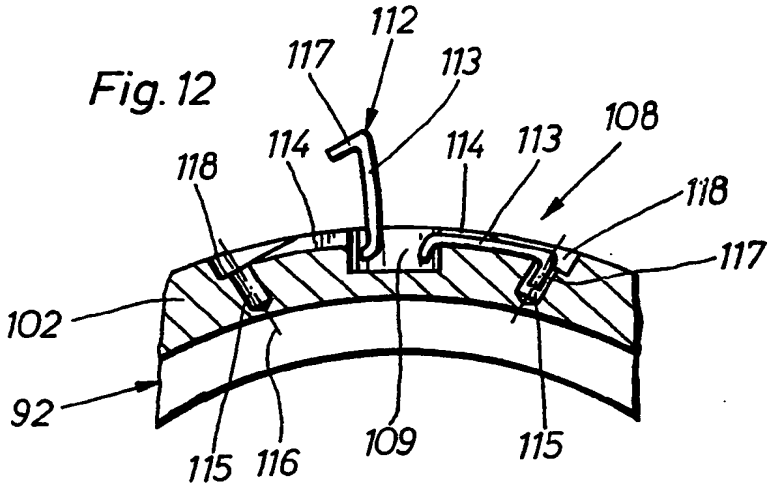
2002660

Fig. 10



2002660

Fig. 12



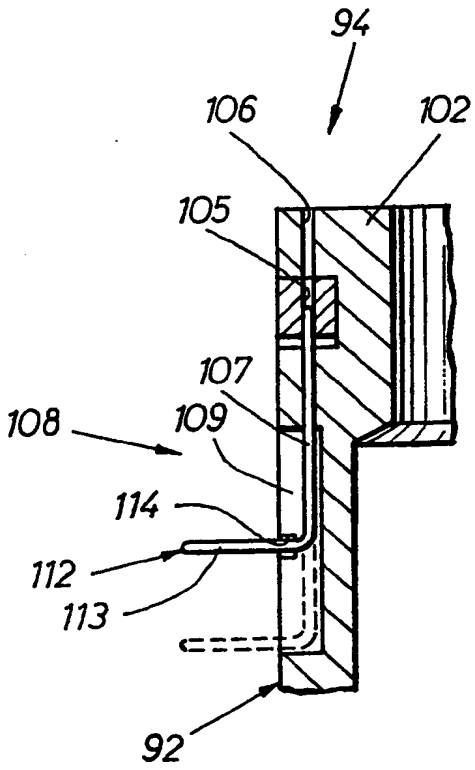


Fig. 13

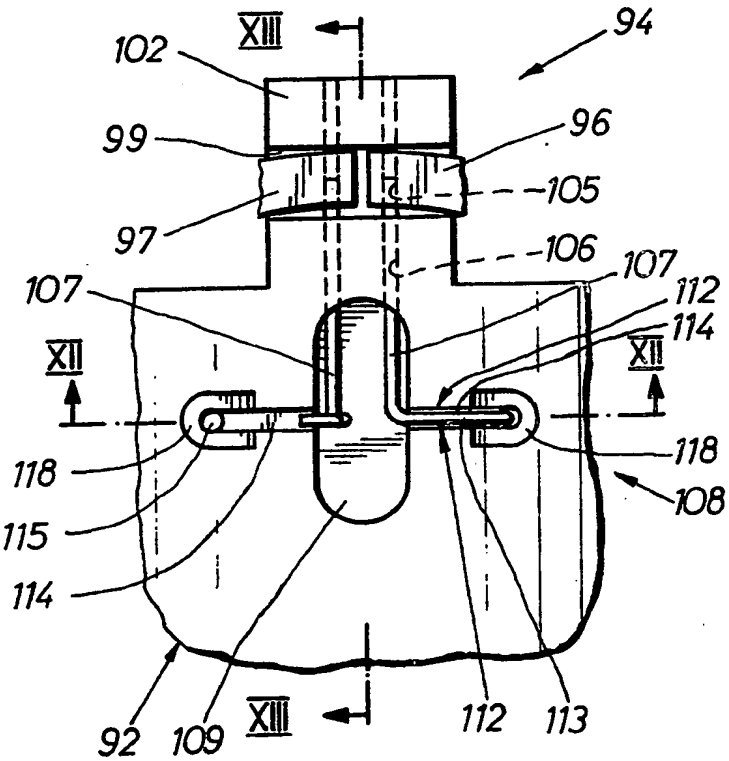


Fig. 11

2002660

Fig. 15

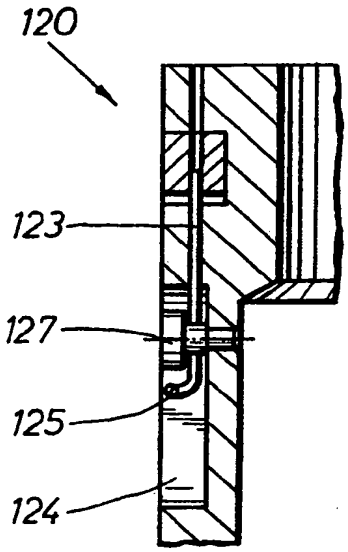
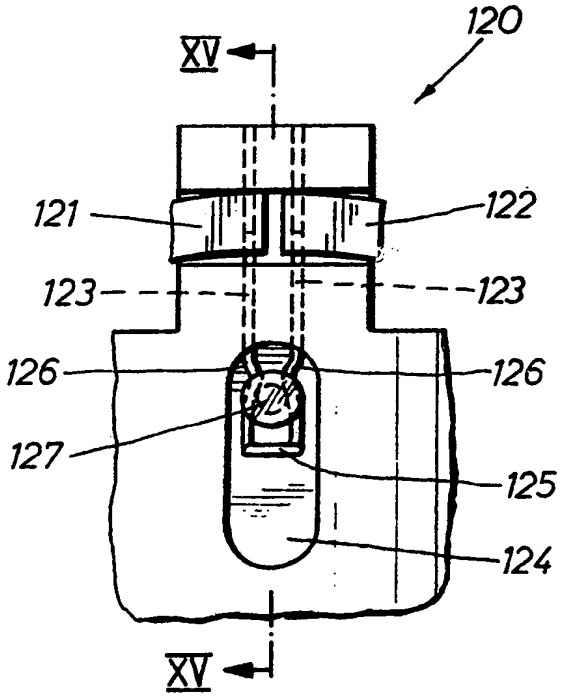
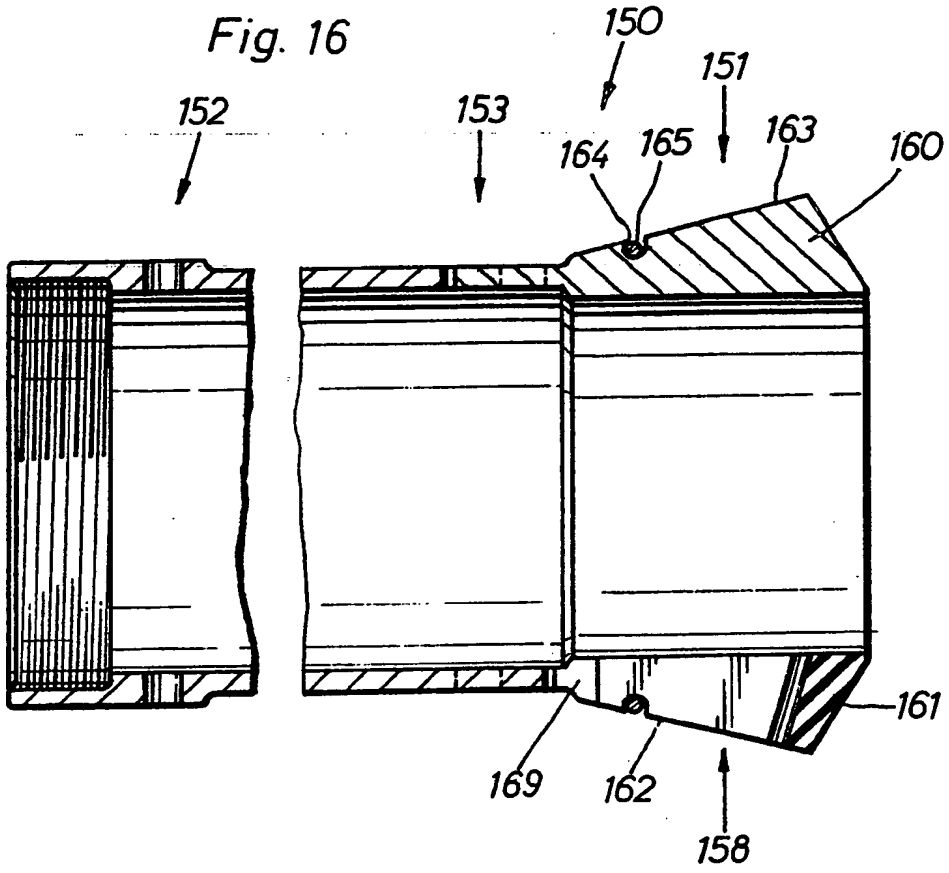


Fig. 14



2002660

Fig. 16



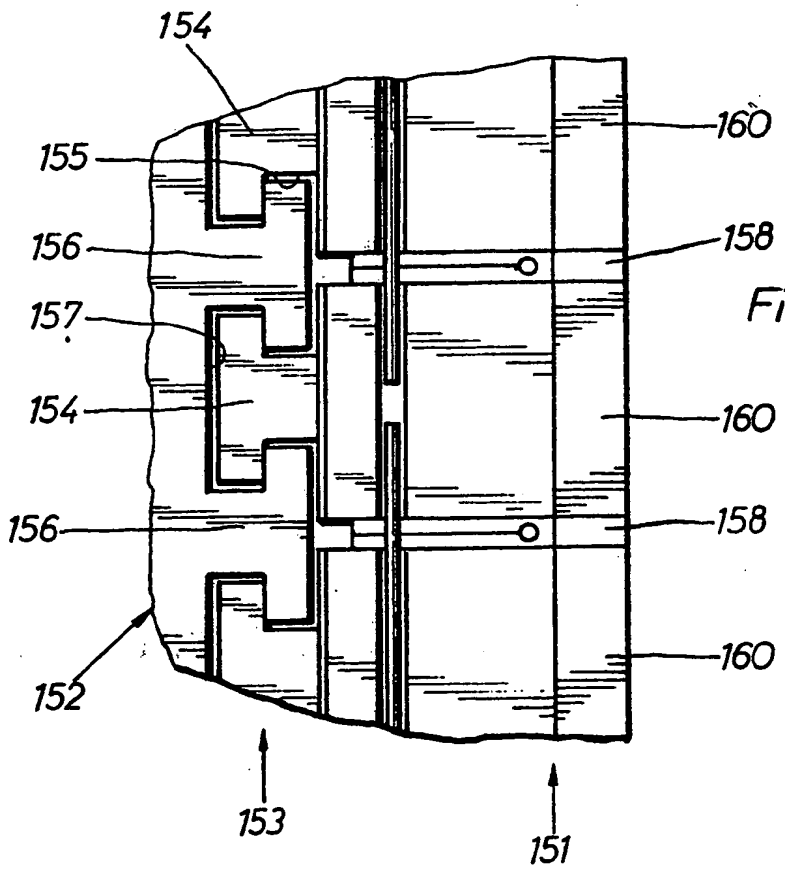


Fig. 17

2002660

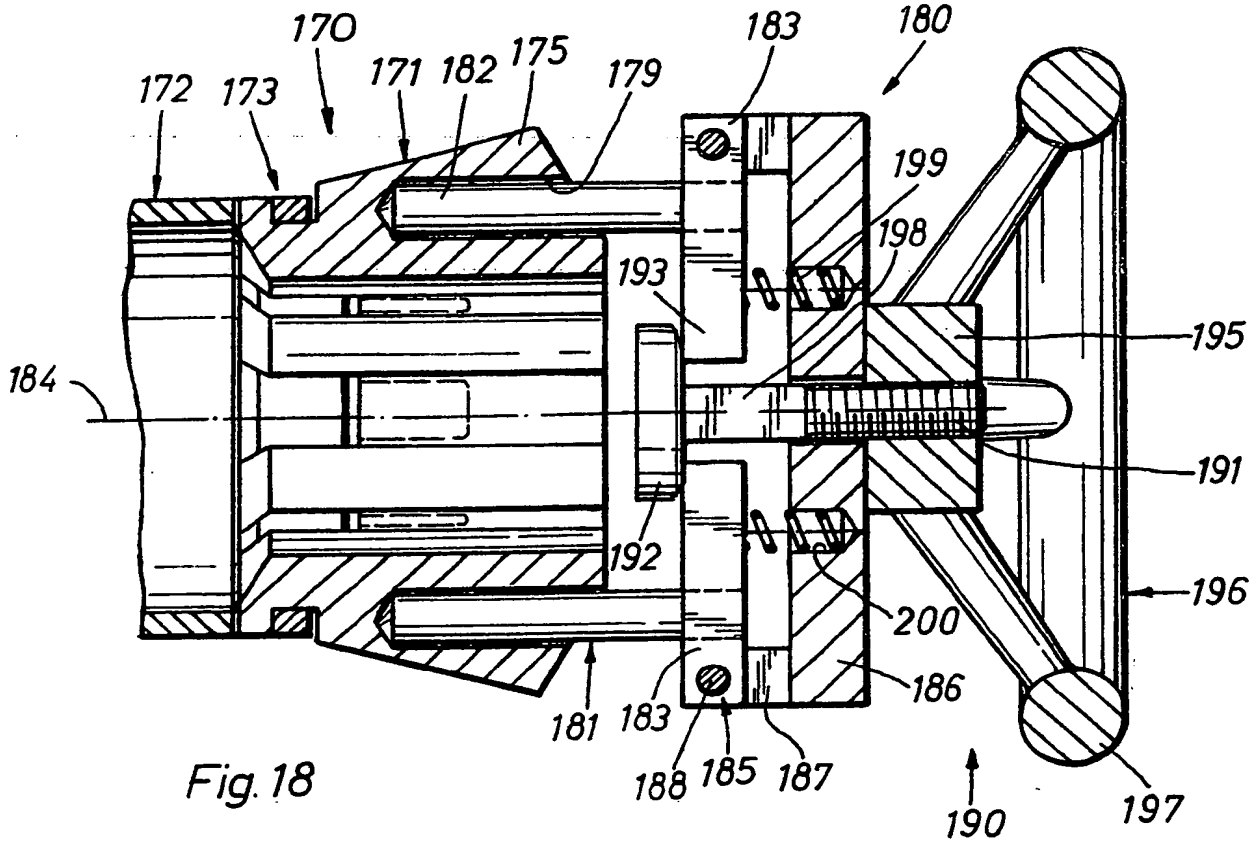


Fig. 18

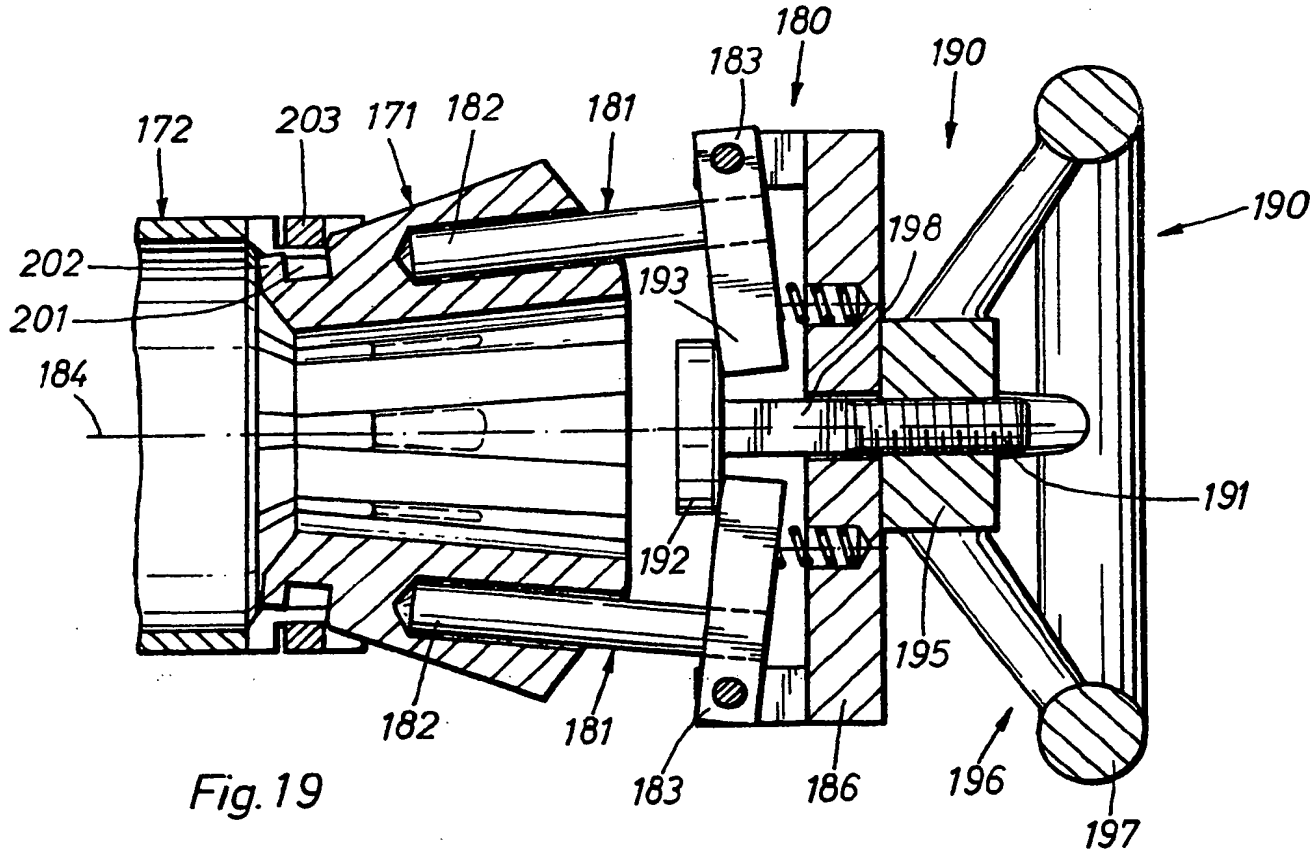
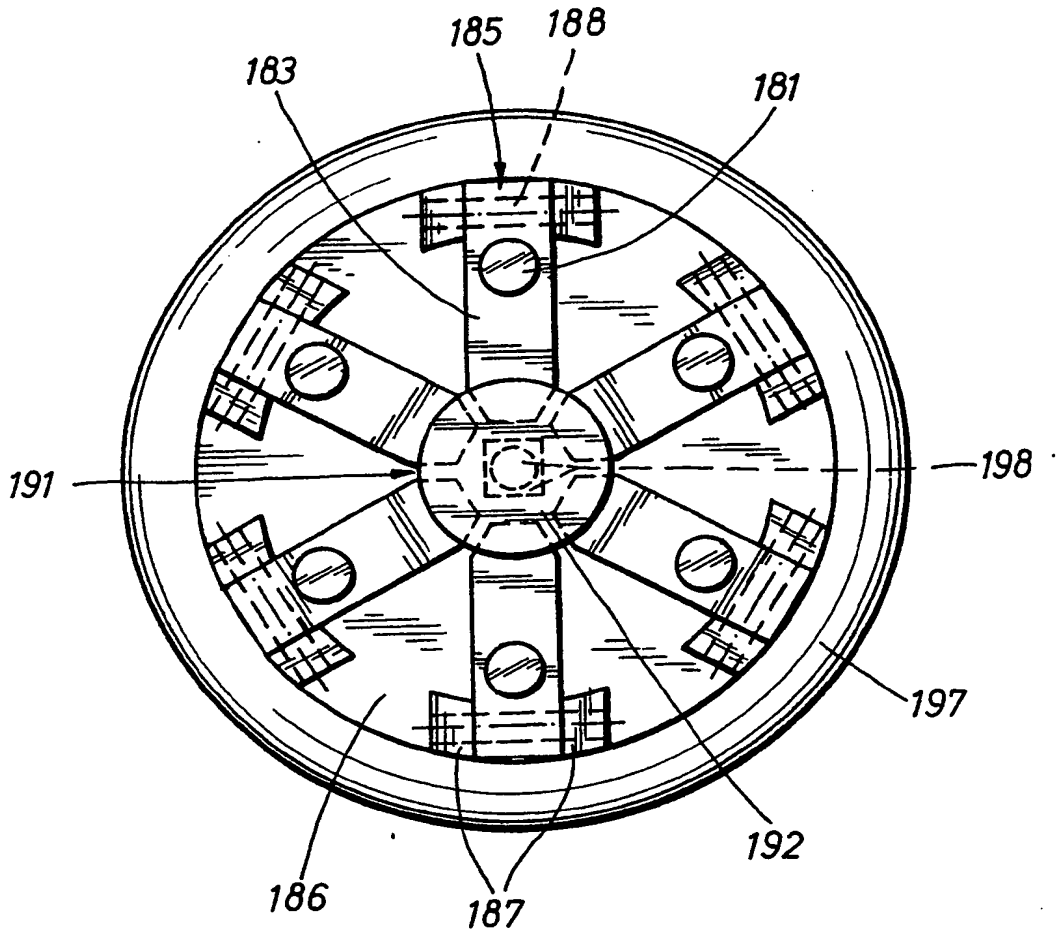


Fig. 19

2002660

Fig. 20



2002660

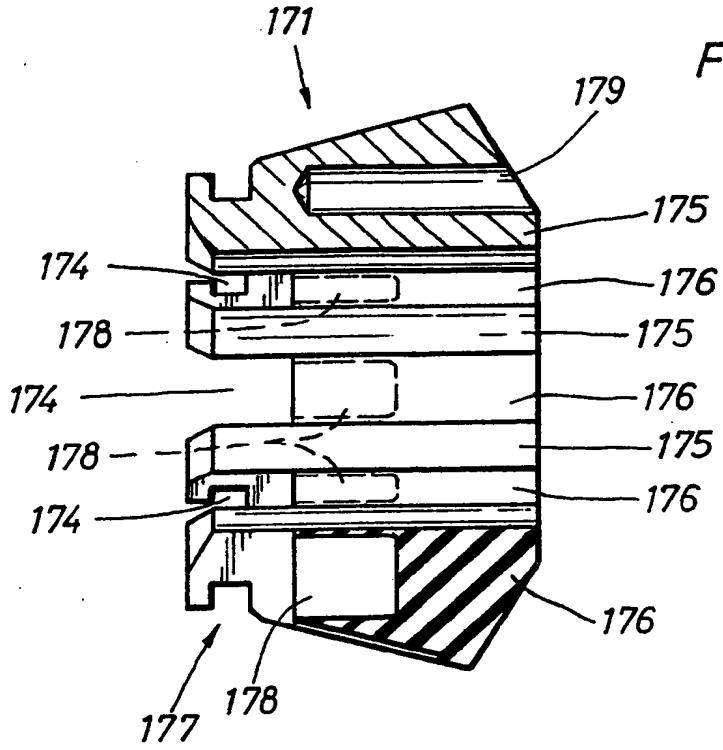


Fig. 21

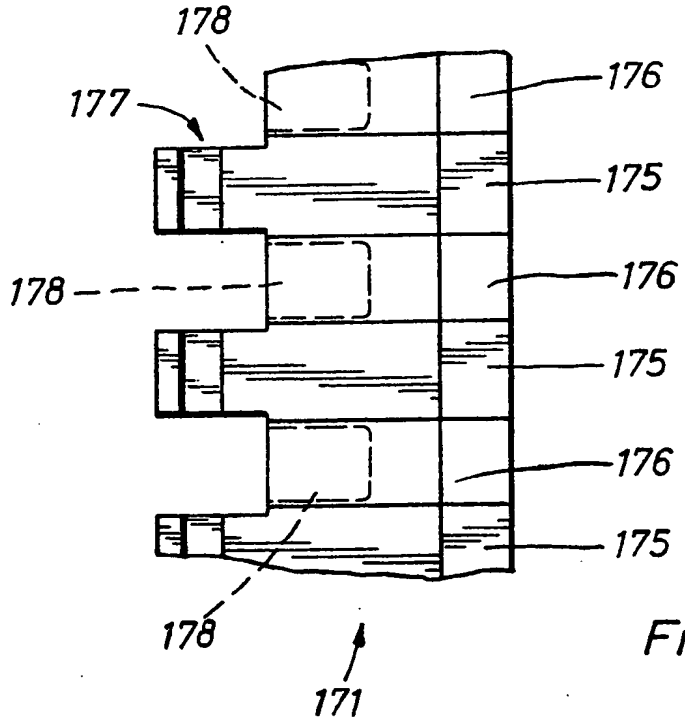


Fig. 22

SPECIFICATION

2-PART COLLET CHUCK

This invention relates to a collet chuck. More specifically it is concerned with a collet chuck having a nose part at one end portion provided with circumferentially spaced jaws which are forced inwardly to grip a workpiece fitted into the nose part, and a tube part at the other end portion formed with a mounting thread to enable the chuck to be screwed onto a draw-in device of a lathe. Hereinafter such a collet chuck will be referred to as a collet chuck "of the type described".

Collet chucks of the type described are frequently used for machining cylindrical workpieces on lathes. This applies to an even greater extent to the processing of barstock or semi-automatic or fully automatic lathes of single-spindle or multi-spindle design.

The collet chucks in a large number of such lathes are clamped by means of a draw-in device. It is possible to distinguish a collet chuck nose and a collet chuck tube in collet chucks of the type described which are suitable at this end. The collet chuck tube part is provided on its interior with clamping surfaces for the workpieces and is provided on its exterior with an external or male frusto-conical surface which flares towards the free endface which is distal from the collet chuck tube part and is at least partially situated in the same longitudinal portion as that occupied by the clamping surfaces. The collet chuck nose part is divided into individual collet jaws by longitudinal slits which are distributed over the circumference and are continuous in the radial direction. These longitudinal slits emerge from the free endface of the collet chuck nose part and extend axially over a longitudinal portion, which forms the actual collet chuck nose part with the clamping surfaces and the external frusto-conical surface, through a middle longitudinal portion, which is tubular in its original state, and through a longitudinal portion which remains unslotted and forms the actual collet chuck tube part. A mounting thread for mounting the collet chuck on the draw-in device of the lathe is provided at the end of the collet chuck tube part which is distal from the collet chuck nose part. Usually the collet chuck tube part is provided on its exterior with a circular cylindrical guide surface whose external diameter is adapted to the internal diameter of the main spindle so as to guide the rear end of the collet chuck in the radial direction when being inserted in the main spindle. The middle longitudinal portion, situated between the actual collet chuck nose part and the actual collet chuck tube part and usually having an external diameter which is less than that of the collet chuck tube part or at least less than the guide surface thereof, is divided by the longitudinal slits into individual blades by means of which the collet jaws of the collet chuck nose part, adjoining at the front end, are able to move resiliently in the radial direction with respect to the collet chuck tube part. The said blades are splayed to a specific degree so that the internal diameter of their chuck jaws in the unstressed state of the collet chuck is greater than the nominal diameter of the chuck so that the workpieces can be inserted without difficulty between the chuck jaws.

At its front end the hollow main spindle of a lathe is provided with an internal taper to which the external taper of the frusto-conical surface of the collet chuck is complementary. The total taper angle of said external taper is usually greater by 10 to 30 minutes of arc than that of said internal taper; said external taper is therefore more obtuse than the internal taper so as to avoid jamming of the chuck jaw in the internal taper.

The draw-in device of a lathe is usually provided with a draw-in tube which extends from the rear end of the main spindle into the said spindle as far as the collet chuck tube part of the collet chucks. At its front end the draw-in tube is provided with a mounting thread complementary to the mounting thread on the collet chuck tube parts of the collet chucks. For use in a lathe, the collet chuck is fixed by being screwed to the draw-in tube and is adjusted therewith axially in relation to the draw-in device so that the external frusto-conical surface providing the taper surfaces of the chuck jaws bear on the internal taper of the main spindle due to the splay of the blades, when the draw-in device is in the released state, but their internal diameter is still greater than the nominal diameter. In the closed position of the draw-in device the internal diameter of the collet jaws is reduced to an undersize in terms of the external diameter of the work pieces, taking into account elastic deformation of the component parts.

In the course of the closing of the clamping motion, the collet jaws, situated at the leading end of the blades, move on an arcuate path and thus perform a pivoting motion. If a workpiece does not have the accurate nominal diameter but is of oversize or undersize, it will be gripped and clamped only by the rear end or front end of the clamping surfaces, i.e. only over a relatively short longitudinal portion. The moment which then occurs on the collet jaws is generally not able to resiliently deform the blades sufficiently to ensure that the clamping surfaces of the collet jaws bear on the workpiece over a substantial longitudinal portion or even over their entire length. Since the tools act on the workpiece outside the clamping zone the risk of the workpiece deflecting under the effect of the cutting forces will be the greater the more the workpiece has an oversize or undersize dimension in relation to the nominal dimension of the collet chuck. Accordingly, the tolerances, more particularly diameter tolerances, on the machine workpiece will therefore be correspondingly larger and there will be a risk of producing chatter marks on the surface of the workpiece. All these features make it necessary to grade the collet chucks of a collet chuck set very closely, a feature which calls for a large number of

collet chucks and results in correspondingly high costs for a collet chuck set. These circumstances also make it necessary to ensure that workpieces have small diameter tolerances and may make it necessary, for example, when processing barstock to use more expensive drawn or shaved bars instead of the less expensive rolled material. Conventional collet chucks are produced from high-grade material, generally tool steel, in view of the high stresses imposed on the collet jaws in the region of the clamping surfaces and of the external cone where a high degree of wear resistance is desired, as well as in the region of the resilient blades in the longitudinal portion between the collet chuck nose part and the collet chuck tube part where a high degree of tensile strength and a high degree of elasticity is desired but such materials can satisfy the varying requirements only to a limited degree. A large proportion of the material volume must be removed by machining in the production of the hollow and usually relatively thin-walled collet chucks. Conventional collet chucks are therefore relatively expensive both in respect of the amount of material used as well as with regard to the production costs.

When collet chucks are changed a conventional collet chuck must be withdrawn from the main spindle over its entire length after being unscrewed from the draw-in tube of the draw-in device. This operation is frequently obstructed by oppositely disposed tool slides or other devices of the lathe and cannot be facilitated in all cases by additional adjusting operations on these devices.

An object of the invention is to provide a collet chuck in which at least some of the above-mentioned disadvantages are avoided or at least reduced.

A collet chuck comprises, in accordance with the present invention, a nose part disconnectably attached to a coaxially arranged tube part by a releasable coupling; the nose part having circumferentially spaced jaws with resilient means provided between them to enable the jaws to move radially independently of one another to bring clamping surfaces of the jaws into contact with a workpiece inserted into the nose part when an externally frusto-conical surface of the nose part is compressed radially inwards; the tube part having a mounting thread for screwing it onto a draw-in device; and, the releasable coupling being formed by co-operating portions of the two parts which transmit torque positively between them and are held in engagement by radially releasable retaining means.

By dividing the collet chuck into two parts which can be separated from each other, only one collet chuck tube part is required for an entire set of collet chucks for coupling with the appropriate collet chuck nose part which has the suitable clamping surface shape and the correct clamping surface dimensions for machining a specific workpiece or blank. Such a collet chuck set, or more accurately such a set of collet chuck nose parts, can also be provided with several collet chuck tube parts, which are either identical to each other, depending on existing lathes, or which are adapted to different lathes, so that several collet chuck nose parts of the set can be used simultaneously on different lathes. The amount of material used is already reduced in the first case and manufacturing expenditure for a collet chuck set in the conventional sense of the word is very substantially reduced. In the last-mentioned case this advantage is greatly increased.

A further advantage in collet chucks according to the invention is that the different requirements of the collet chuck nose part and the collet chuck tube part can be more readily satisfied by a suitable selection of the material from which they are made. The two parts can be processed readily by chip-forming machining while separate from each other. The technological production stages such as carburizing, hardening, tempering and so forth can be performed much more readily on the separate parts to the extent to which such operations are necessary, and can be adapted more readily to the requirements of the individual parts.

Another advantage is that the smaller dimensions of the collet chuck nose part as compared with conventional complete collet chucks, means that the space required for storing an entire collet chuck set is substantially reduced.

When changing collet chucks on a lathe with restricted space conditions it is sufficient to advance the draw-in tube of the draw-in device with the collet chuck mounted thereon in the main spindle only to the extent that the coupling device is accessible from the outside and can be opened. Thereafter only the collet chuck nose part is removed and exchanged for another.

The retaining means used in the coupling for connecting the collet chuck nose part to the collet chuck tube part enable the individual collet jaws of the collet chuck nose part to perform a purely radial clamping motion during the clamping operation. The tapered exteriors of the jaws will normally bear over their entire length on the internal taper of the main spindle. Compared with conventional collet chucks the same clamping force is therefore achieved with reduced surface pressure between the external frusto-conical taper surface of the nose part and the internal taper surface of the main spindle. Wear of the taper surfaces is therefore also reduced. Owing to the radial clamping motion of the collet jaws the clamping surfaces thereof remain in parallel alignment with the longitudinal axis. Workpieces can thus be clamped over the entire length of the clamping surfaces. Deflection of the workpieces due to cutting forces is then minimised. The diameter tolerances on finish-machined workpieces are therefore smaller, the concentricity is more accurately maintained and the surface finish is improved. Reliable splaying of the collet jaws after releasing the collet chuck is ensured by the resilient means between the individual collet jaws. Accordingly, the taper

angle of the external frusto-conical surface of the collet chuck nose can be made identical to that of the internal taper of the main spindle, a feature which also facilitates uniform contact between the taper surfaces against each other and of the clamping surfaces on the workpieces over their whole length.

The resilient means can be provided in a very simple manner for example by the use of an elastomeric or rubber elastic compound bonded or otherwise attached to the collet jaws, for example by adhesive bonding casting or vulcanizing. Such means can also serve to retain the individual collet jaws in their correct mutual coordination with each other. If the rubber elastic compound fills the longitudinal slots, at least in the front part near the free endface of the collet chuck nose part preferably from the region of the clamping surfaces as far as the external frusto-conical surface extends, this will also provide good sealing against the ingress of dirt and foreign matter, more particularly of metal chips.

Preferably the coupling has the cooperating portions comprising circumferentially distributed projections alternating with recesses on each of the two parts, the projections of one part being accommodated in the recesses of the other part and being held in position by a divided coupling ring forming said retaining means and accommodated in a circumferential groove sections of which are formed in the projections of the two parts.

Such a coupling device is very adaptable. By means of this device the two parts of the collet chuck can be simply plugged together so as to be coupled to each other. The two parts are prevented from rotating relative to each other by the projections so that a torque can be transmitted between an effective tongue-and-groove connection between the collet chuck nose part and the collet chuck tube part, for example in order to release the collet chuck from the draw-in-tube of the draw-in device. Coupling and decoupling of the two parts of the collet chuck is still further facilitated in a collet chuck if the coupling ring is divided up circumferentially.

Embodiments of the invention will now be described in more detail, by way of example, with reference to the accompanying partly diagrammatic drawings, in which:—

Figure 1 is a longitudinal section through a collet chuck along the line I—I of Figure 2;

Figure 2 is an end view of the collet chuck according to Figure 1;

Figure 3 is a partial development of the collet chuck according to Figure 1 with a coupling ring removed;

Figures 4 and 5 each represent an end view of respectively each of two constructions of coupling ring for the collet chuck according to Figure 1;

Figure 6 is an end view of a third construction of coupling ring for the collet chuck of Figure 1;

Figure 7 is a cross-section through the coupling ring according to Figure 6 along the line VII—VII;

Figure 8 is an exploded longitudinal section through a second embodiment of collet chuck;

Figure 9 is a partial side and partially sectioned development of the collet chuck according to Figure 8;

Figure 10 illustrates a development of the second embodiment of the collet chuck;

Figure 11 shows part of the development of Figure 10 to a larger scale and partially assembled;

Figure 12 is a partial cross-section along the line XII—XII of Figure 11;

Figure 13 is a partial longitudinal section through the collet chuck of Figure 10 and taken along the line XIII—XIII of Figure 11;

Figure 14 illustrates a second development of the collet chuck of Figure 10;

Figure 15 is a partial longitudinal section through the collet chuck development according to Figure 14;

Figure 16 is a longitudinal section, partially broken away, of a portion of a fifth embodiment of collet chuck;

Figure 17 shows part of the circumference of the portion of the collet chuck according to Figure 16;

Figures 18 and 19 show in longitudinal section a sixth embodiment of the collet chuck with a changeover device, and respectively in two different operating positions of the changeover device and the collet chuck parts which cooperate therewith;

Figure 20 is an end view of the changeover device according to Figure 18;

Figure 21 is a longitudinal section through the collet chuck nose part of the collet chuck according to Figure 18 (along a sectional line corresponding to the line I—I of Figure 2); and

Figure 22 is a circumferential development of part of a collet chuck nose part according to Figure 21.

In the first embodiment shown in Figures 1 to 3 the collet chuck 20 comprises a collet chuck nose part 21, a collet chuck tube part 22 and a coupling device 23. The collet chuck nose part 21 and the collet chuck tube part 22 are independent components which can be separated from each other and are positively coupled to each other in the axial direction by means of the coupling device 23.

The outer surface of the collet chuck nose part 21 has approximately the shape of a hollow truncated cone. On its interior it has clamping surfaces 24 for the workpieces which are to be clamped. The clamping surfaces are usually circular cylindrical surfaces. They can however also have other shapes. The clamping surfaces 24 extend from the free end face of the collet chuck nose part 21 on the right of Figure 1 axially almost over the entire length of the collet chuck nose part. The exterior of the collet chuck nose part 21 has a first frusto-conical surface 25 which diverges towards the free endface and is adapted to the internal taper associated with a main spindle of the lathe for which the collet chuck 20 is

intended. The angle of divergence of the surface 25 is about 15°. The surface 25 is shorter in the axial direction than the collet chuck nose part 21. The front end of the surface 25 adjoins a frusto-conical transition surface 26 which converges at an angle of 150° and extends to the plane endface 27 at the free end of the collet chuck nose part 21. An approximately hollow cylindrical coupling part 28, which also forms the rear end of the collet chuck nose part 21, adjoins the rear end of the external surface 25.

The collet chuck nose part 21 is divided into individual collet jaws 30 by longitudinal slits 29 which are continuous in the radial as well as in the axial direction. Six longitudinal slits and therefore six collet jaws are illustrated in this and other embodiments of the collet chuck. These numbers can however also be smaller or greater.

The spaces produced by the longitudinal slits 29 between the individual collet jaws 30 are substantially filled with a rubber elastic compound 31. An elastomer, namely of cross-linked polyurethane, has been found particularly advantageous to this end. As can be seen by reference to Figure 1 the rubber elastic compound 31 extends radially from the clamping surface 24 to the external surface 25, at least into the front part thereof and extends radially from the transition surface 26 and the endface 27 to the coupling part 28. In its flowable state the rubber elastic compound 31 is introduced into the space between the collet jaws 30 which are inserted into a casting mould and the compound is then changed by heat treatment into a solid state in which it is bonded to the inward facing wall surfaces 32 of the collet jaws 30. The rubber elastic compound 31 therefore ensures that the collet jaws 30 are retained together in the collet chuck nose part 21 and also forms a rubber spring which acts on the collet jaws in the circumferential direction and applies a splaying force to the collet chuck nose part 21 when this part is released after a clamping operation.

The collet chuck tube part 22 of the collet chuck 20 is constructed in tubular form over its entire length. At the rear end which is distal from the collet chuck nose part 21 it is provided with a mounting thread 33 for mounting on a draw-in device of a lathe. Over the longitudinal exterior surface situated near the rear end, the collet chuck tube part 21 is provided with a cylindrical guide surface 34 the external diameter of which is larger than that of the remainder of the collet chuck tube part 22 and is adapted to the internal diameter in this axial region of a main spindle associated with the lathe so that together with the said internal diameter it provides additional guiding for the collet chuck. Two transverse bores 35 are also provided in the region of the guide surface 34 for the attachment of tools to enable the collet chuck tube part to be screw-mounted on the draw-in device of the lathe or to be detached therefrom.

A coupling member 36 is situated on the end of the collet chuck tube part 22 which is distal from the mounting thread 33 and nearest to the collet chuck nose part 21. The coupling member 28 of the collet chuck nose part 21 and the coupling member 36 of the collet chuck tube part 22 function as parts of a coupling device 23 have axial extensions 37 or 38 and interposed recesses 39 or 40 which are distributed circumferentially and each of which is constructed so that the extensions 37 or 38 of one collet chuck part 21 or 22 and the recesses 40 or 39 of the other collet chuck part 22 or 21 can interengage with each other axially in the manner of claws as can be seen more particularly by reference to Figure 3.

A coupling ring 43 whose cross-sectional shape, diameter and width are adapted to a common circumferential groove formed by arcuate registering groove sections 41, 42 in the claws is inserted therein as a further part of the coupling device 23. In the simplest case the coupling ring 43 is divided at a place on the circumference so that it can be elastically expanded to enable it to be slid on to the collet chuck tube part 22 when the collet chuck nose part 21 is removed. After joining a collet chuck nose part 21 to the collet chuck tube part 22 the coupling ring 43 is slid over the common circumferential groove formed by the arcuate groove sections 41, 42 until it snaps into the said groove and thus positively couples both collet chuck parts 21 and 22 in the axial direction. The collet jaws 30 of the collet chuck nose part 21 can move radially with respect to the collet chuck tube part 22 within specific limits which are defined more particularly by the radial thickness of the coupling ring 43 and the corresponding groove depth of the circumferential groove 41, 42, as well as by the axial pull required to provide a specific clamping force.

The collet chuck nose part 21 and the collet chuck tube 22 are produced from carburized steel. The collet chuck nose part 21 is carburized and hardened in the region of the clamping surface 24, in the region of the external frusto-conical surface 25 and in the region of the coupling member 28. The collet chuck tube part 22 is carburized and hardened in the region of its coupling member 36. The coupling ring 43 is produced from heat-treated steel and is substantially hardened and tempered. The relevant surfaces of the aforementioned components are ground to the extent to which this is common practice or necessary in the region of the coupling device 23.

Handling the coupling ring of the above-described coupling device between the collet chuck nose part 21 and the collet chuck tube part 22 is facilitated if the coupling ring is divided at two places of the circumference.

The coupling ring 45 shown in Figure 5 is divided at two diametrically opposite circumferential places 46. A positional safety device 47 is provided for the two ring halves which are situated loosely in the circumferential groove 41, 42. Each of the positional safety devices is formed by a radial projection 48 and a

radial recess 49 each of which is provided on both of the ends of the ring halves which are associated with each other at the circumferential or dividing places 46. When the ring halves are joined the projections 48 engage behind each other and latch resiliently in the adjoining recesses 49 and thus retain the two ring halves together.

Figures 6 and 7 show another embodiment of a coupling ring 51 divided into two parts. This embodiment is also divided at two diametrically opposite circumferential places or dividing places 52. The inward facing ends of the ring halves in this case are flat. On its circumferential surface the coupling ring 51 is provided with a circumferential groove 53 into which a spring elastic locking ring is inserted to function as positional safety device and which is divided only at one circumferential place 55. By virtue of its spring force it retains the two halves of the coupling ring 51 together in the circumferential groove of the coupling device.

The second embodiment of the collet chuck shown in Figures 8 and 9 is modified with respect to the first embodiment only with respect to the shape of the coupling ring and as regards the positional safety device. Unless separately described reference should be made to corresponding parts of the first embodiment as regards the remaining features.

The collet chuck 60 comprises the collet chuck nose part 61 and the collet chuck tube part 62 both of which are positively coupled to each other in the axial direction by means of the coupling device 63. As part of the coupling device 63 the two collet chuck parts 62 and 63 are provided at their opposed ends with axial extensions 64 and intermediately disposed recesses 65 or with axial extensions 66 and the intermediately disposed recess 67 which are adapted to interengage axially with each other in the manner of claws. The circumferential groove sections 68 on the collet chuck nose part 61 and the circumferential groove sections 69 on the collet tube part 62 are provided as further components of the coupling device 63 on a longitudinal portion of a chuck which is common to both after both collet chuck parts are joined to each other. The coupling ring 71 is inserted into the common circumferential groove formed by the groove sections 68, 69 to function as further component of the coupling device 63.

As can be seen by reference to Figure 9 the coupling ring 71, has a ripple profile formed by circumferentially corrugating it. The distance between adjacent corrugation peaks on the same side is at least approximately equal to the distance between the longitudinal centre lines of the axial extensions 64 or 66 of the associated end of the collet chuck part 61 or of the collet tube part 62, which is shown developed into the same plane. The corrugations of the coupling ring 71 have an internal height which is at least equal to but preferably slightly greater than the elastic deformation each individual corrugation is likely to experience as a result of the axial pull which it is required to absorb when in use. This avoids edge pressure on the coupling ring. Means are provided for maintaining the position of the coupling ring 71 in the circumferential direction so that each of the corrugation peaks on both sides of the coupling ring 71 faces the free end of the axial extensions 64 and 66 while being at least approximately in alignment with the longitudinal centre lines of the axial extensions, as can be seen by reference to Figure 9.

The coupling ring 71 is divided into the two ring halves 72 and 73 at two diametrically disposed circumferential places or dividing places. As can be seen by reference to Figure 9 the dividing places are situated at a corrugation peak of the coupling ring 71.

At the ring ends adjacent a dividing place, each of the two ring halves 72 and 73 is pivotably supported on the collet chuck tube part 62 by means of a pivoting joint 74 or 75 so that the position of the corrugation peaks in relation to the axial extensions 64 and 66 is also defined in the circumferential direction. The pivoting axis of the pivoting joints 74 and 75 is aligned parallel with the longitudinal axis of the collet chuck 60. Each of the pivoting joints 74 and 75 is formed with the help of an axially oriented bore 76 in the coupling ring 71 and by a bore 77, in flush alignment with the first-mentioned bore, in one of the axial extensions 66 of the collet chuck tube part 62. A pivot pin 78 is inserted into the two bores 76 and 77, a device which prevents axial sliding displacement of the pivot pin 78 is provided for both pivoting joints 74 and 75. One part of the device is formed by a neck or circumferential groove 79 provided on each of the joint pins on a longitudinal portion which extends within the collet chuck tube part 62. The other part is formed by a locking member or pin 81, shown in Figure 9, inserted into a radially oriented bore which is disposed on the collet chuck tube part 62 so that diametrically opposite parts cylindrical surfaces of the locking pin 81 engage respectively in the circumferential grooves 79 of the parallel joint pins 78 flanking it.

The two ring halves 72 and 73 can be pivoted out of their operating position in the common circumferential groove by turning about their pivoting joints 74 and 75 so that all axial extensions 64 of the collet chuck nose part 61 are released by the coupling ring 71 and the collet chuck nose part 61 can be removed in the axial direction from the collet chuck tube part 62 and can be exchanged for another collet chuck nose part. The two ring halves 72 and 73 are then again pivoted back into their operating positions and the inserted collet chuck nose part is thus coupled to the collet chuck tube part. The ring halves 72 and 73 are captively joined to the collet chuck tube part 62 by means of the pivoting joints 74 and 75 so that they can be neither mislaid, when the collet chuck nose part is exchanged, nor can they become dirty or interchanged when they are put down.

It is necessary to secure the outwardly

pivotable part of each of the two ring halves 72 and 73 since the pivoting joints 74 and 75 can secure the two ring halves 72 and 73 in the circumferential groove only at one end, the free ends of the ring halves being capable of moving in the radial direction. Such securing is accomplished by a ratchet device 82 shown in Figure 9.

A part of the ratchet device 82 which functions as a latch is formed by a ratchet ball 83 which is inserted into an axially oriented bore 84, in alignment with the endfaces of the circumferential groove 68 for the coupling ring 71 and is disposed in one of the collet jaws 85 of the collet chuck nose 61. A collar 86, whose internal diameter is slightly smaller than the external diameter of the ratchet ball 83, is provided at that end of the bore 84 which faces the circumferential groove 68. A helical compression spring 87 thrusts the ratchet ball 83 in the bore 84 against the collar 86 so that part of the ratchet ball 83 projects from the bore 84 into the circumferential groove 68. The other end of the helical compression spring 87 is borne on by a screw 88 which is screwed into the threaded beginning of the bore 84.

The other part of the ratchet device 82 is formed by a conical or spherical sector-shaped socket or notch 89 shown in Figure 8 and which is provided in the endface of the associated ring half 73 of the coupling 71 in alignment with the bore 84 and facing the same.

As can be seen by reference to Figure 9 the ratchet device 82 for one ring half 73 is disposed approximately in the longitudinal middle plane of the collet jaw 85 adjacent to the freely pivotable end of the aforementioned ring half so that the ratchet ball 83 and the ratchet notch 89 are situated in the endface region of the circumferential groove 68 or of the ring half 73 in which no thrust forces are transmitted when a load is applied to the coupling device 63.

It is advisable to provide the coupling device with different means for securing the positions of the two ring halves, if a collet chuck with a coupling device such as that previously described with two pivotably supported coupling ring halves is to be used in a lathe with very high spindle speeds. This results in a correspondingly large centrifugal force and/or with a main spindle having a large internal diameter in the region of the coupling ring in relation to the external diameter thereof. There is consequently a correspondingly large pivoting range of the ring halves within the main spindle. A suitable securing means for this purpose is shown in Figures 10, 11, 12 and 13 and it offers the advantages of a high degree of safety while not requiring excessive effort to use.

The collet chuck 90 with the collet chuck part 91, the collet chuck tube part 92 and some of the parts of the coupling device 93 are substantially identical to the previously described collet chuck 60 of Figures 8 and 9. The coupling device, here referenced 93, has a coupling ripple or wavy ring 95, comprising two halves, namely the ring halves 96 and 97. These are situated in a circumferential groove formed by aligned groove sections 98 or 99 of the collet chuck nose part 91 and the collet chuck tube part 92, situated in the axial extensions 101 or 102. Each of the two ring halves 96 and 97 is pivotably supported by means of a pivoting joint 103 or 104 in one of the two axial extensions 102 of the collet chuck tube part 92.

Each of the position locking means 94 of a ring half 96 or 97 includes two bores 105 and 106 in alignment with each other, of which the bore 105 is disposed at the freely pivotable end of the ring half 96 or 97 and the other bore 106 is disposed at the particular axial extension 102 of the collet chuck tube part 92 which is situated diametrically opposite to the axial extension 102 with the pivoting joints 103 and 104. Each position locking device 94 also includes a locking pin 107 which is longitudinally slidably guided in the two bores 105 and 106 between a locked position and a released position. In the locked position the locking pin 107 extends into both bores 105 and 106. In the released position the pin is disposed exclusively in the bore 106 of the collet chuck tube part 92 so that the end of the ring half 96 can be pivoted out of the circumferential groove 98, 99.

Each of the two locking pins 107 is provided with a side lock 108 by means of which the locking pin can be secured in its locked position and in which the pin is prevented from being slid into the "release" position. A recess 109 is provided on the exterior of the collet chuck tube part 92 for accommodating operating movement of the locking pins 107. The recess is disposed in line with the bores 106 for the two closely adjacent locking pins 107 associated with the ring half 96 or 97 of the coupling ring 95. Both bores 106 extend freely into the recess. The rear ends of the locking pins 107 lie in the recess 109 in the locked position (full line in Figure 13) as well as in the release position (dotted line in Figure 13) so that they can be gripped and slid between their two positions either manually or with a tool. The locking pins 107 are longer than the axial extent of the recess 109 so that the locking pins can be inserted into the bores 106 only by resilient deformation. Accordingly, they can also not be removed from the bores 106 without resilient deformation. They cannot therefore be lost when the collet chuck tube part 92 is handled.

The side lock 108 for each of the two locking pins 107 is constructed in the manner of a so-called Grendel bolt having a branch slot 114 and an arm 112 locatable in the slot. The arm 112 is formed by a longitudinal portion 113 of the locking pin 107 which is bent through 90° laterally of the recess 109. The slot 114 opens into the side of the first recess 109. The slot 114 is only slightly broader than the thickness of the longitudinal portion 113 of the locking pin 107. It is disposed so that when the locking pin 107 is in the locked position the slide 112 can be pivoted into the slot 114 by a pivoting motion about the longitudinal axis of the locking pin 107.

In the interests of easy handling, the

longitudinal portion 113 of the locking pin 107 is made of a length such that when it is in the posiion in which it projects away from the bolt slot 114 (see the pin on the left of Figures 12 and 13) the chuck cannot be fitted into the main spindle of a lathe. The collet chuck 90 can be inserted into the main spindle only when the side locks 108 are in the completely secured state. The side lock 108 can be released, i.e. the slide 112 can be pivoted out of the slot 114 and the locking means 94 can be released, only when the chuck is off the main spindle. The locking pin 107 can then be moved from the position shown in solid lines in Figure 13 into that shown in broken lines once the longitudinal portion 113 has been released from the slot 114.

To avoid damaging the longitudinal portions 113 of the side locks 108 when the collet chuck 90 is handled, more particularly when the chuck is applied to a main spindle, the portions 113 are restrained against unintentional outward pivoting. To this end the second slot 114 opens at its end into a rebate 118 containing a cylindrical well 115 whose longitudinal axis 116 extends obliquely to the radial line passing from the axis of the chuck to the well mouth and chordally with respect to the locking pin 107. The well therefore slightly undercuts the slot 114. The terminal portion 117 of the arm 112 is cranked over at 117 so that it can be sprung resiliently beneath the undercut and into the well 115 in order to retain the longitudinal portion 113 of the pin 107 latched, when the pin 107 is in its ring-half locking position (see Figure 11).

The rebate 118 is produced by an end mill whose longitudinal axis is aligned parallel with the longitudinal axis of the well 115. Accordingly, the floor of the expanded portion 118 extends at a normal to the longitudinal axis 116 of the well 115 which facilitates the subsequent production thereof. A tool, for example the blade of a screwdriver, is able to grip under the longitudinal portion 113 of the locking pin 107 in the rebate 118 and the pin terminal portion 117 can thus be easily levered out of the well 115.

In the embodiment illustrated in Figures 14 and 15 only the lock of the slide pin is modified with respect to the previously described embodiment and all details in all other respects are identically or at least similarly constructed. A lock 120 for two ring halves 121 and 122 comprises two pins 123 and which are joined together at the rear end which extends into a recess 124. A connecting member 125, joins the pins 123 so that a member of integrally hair-pin configuration results. An inwardly oriented deformation 126 is formed on each pin 123 within the recess 124. A retaining stud 127 is mounted in the base of the recess 124 with its stem in the path of motion of the two deformations 126. The bear upon the stem of the stud 127 prevent any deliberate sliding of the locking pins 123 from the locked position into the released position. To obtain such displacement it is necessary to apply a force on the connecting member 125 sufficient to overcome the deformation resistance of the locking pin 123 and to enable the deformations 126 to pass the stem of the stud 127. To facilitate the application of such force the connecting member 125 is bent open outwardly in the radial direction as can be seen by reference to Figure 15.

The collet chuck 150 shown in Figures 16 and 17 comprises a collet chuck nose part 151 and a collet chuck tube part 152 which are substantially identical to corresponding parts of the previously described collet chucks. A coupling device 153 between these two collet chuck parts, on the other hand is different. The coupling device is associated with axial extensions 154 which are distributed in the circumferential direction and intermediately disposed recesses 155 on the end of the collet chuck nose part 151 nearest to the collet chuck tube part 152 and like axial extensions 156 and intermediately disposed recesses 157 on the end of the collet chuck tube part 152 nearest to the collet chuck nose part 151 all of which, bent into a plane, have a T-shaped plan view. The extensions 154 of the collet chuck nose part 151 fit into the recesses 157 of the collet chuck tube part 152 and conversely the extensions 156 of the collet chuck tube part 152 fit into the recesses of the collet chuck nose part 151. Pull is transmitted *via* axial endfaces which bear upon each other on the underside of the cross-arms associated with the T-section, nearest to the stem member. The coupling device 153 also transmits torques between the collet chuck nose part 151 and the collet chuck tube part 152.

A rubber elastic compound 158 almost completely fills longitudinal slits 159 between individual collet jaws 160 of the collet chuck nose part 151 in the collet chuck 150. The compound however fixedly joins the collet jaws to each other only in the front region 161 of the longitudinal slits while it is split in the middle and rear regions 162, approximately along the longitudinal middle plane as shown in Figure 17. The front region 161 of the rubber elastic compound 158 therefore forms a rubber joint by means of which the rear ends of the collet jaws 160 with the axial extensions 154 are splayed and can be pivoted into the recesses 157 of the collet chuck tube part 152. A circumferential groove 164 into which a retaining ring 165 is inserted is provided in the rear half of an external frusto-conical surface 163 associated with the collet chuck nose part 151.

In the embodiment illustrated in Figures 18 to 22 a collet chuck 170 comprises a collet chuck nose part 171 and a collet chuck tube part 172 which are axially coupled with each other by means of a coupling device 173. These parts of the collet chuck 170 are identical or at least similar to corresponding parts of the collet chuck 90 described above with reference to Figures 10 to 13, unless otherwise stated hereinbelow.

The collet chuck nose part 171 differs from the collet chuck nose part 91 by broader longitudinal slits 174 between the collet jaws 175 as shown in Figure 21. Accordingly, a rubber elastic compound 176 between the collet jaws 175 had a

greater thickness in the circumferential direction and therefore an increased yield with respect to relative changes of position of the collet jaws 175. Recesses 178, constructed as cavities which are open at the rear towards the coupling device, are provided in the rubber elastic compound 176 from the coupling side end of the collet chuck nose part 171 to increase the yield of the rubber elastic compound 176, more particularly in the region of the coupling part 177 associated with the collet jaws 175. The recesses 178 are generally moulded at the same time at which the rubber elastic compound 176 is introduced into the longitudinal slits 174. They can however also be produced subsequently by drilling or milling. To prevent chips and dirt being deposited in the recesses 177 they can be closed by adhesively bonded, thin-walled and resilient lids of the same material.

Each collet jaw 175 has a cylindrical bore 179, oriented parallel with the longitudinal axis of the collet chuck 130 and extending in the form of a blind hole from the front endface, distal from the coupling part 177, into the collet jaw, as seen more particularly by reference to Figures 18, 19 and 21. The bores 179 are disposed on the collet jaw nose part 171 on the same pitch circle. They are provided for the insertion of a changeover device 180 by means of which the collet chuck nose part 171 can be disengaged from the collet chuck tube part 172 in the main spindle of a lathe without opening the coupling device 173 and can be exchanged for another collet chuck nose part, for example with a different clamping surface diameter or a different clamping surface shape.

For each collet jaw 175 of the collet chuck nose part 171 the changeover device 180 is provided with a coupling element or pin 181 which is constructed in the form of a cylindrical pin. The external diameter of the pins 181, at least in the region of the part 180 for coupling to the collet chuck nose part 171, is slightly smaller than the internal diameter of the bores 179 so that manufacturing tolerances of the bores 179 or of the changeover device 180 can be more readily compensated and to facilitate coupling the changeover device 180 to the collet jaw nose part 171.

One end of each coupling pin 181 is held by being press fitted in a bore of a pivoting arm 183. In the unstressed state of the changeover device 180, illustrated in Figure 18, the pivoting arms 183 are at least approximately radially arranged with respect to the longitudinal axis 184 of the collet chuck 170. At the end distal from the longitudinal axis 184 each pivoting arm 183 is held by a hinge 185. A bearing member 186 constructed as a circular disc, has one endface provided with pairs of bearing blocks 187 which are uniformly distributed around the external margin. These bearing blocks are milled from an initially annular collar of the disc-shaped bearing member 186. Each pair of bearing blocks 187 and eacb pivoting arm 183 is provided with a bore, matched to each other, into which a hinge pin 188 is inserted to complete the hinge.

An operating device 190 is provided for stressing the changeover device 180, i.e. for inward pivoting of the coupling elements 181. An adjusting element 191, constructed as a screwthreaded bolt one end of which is provided with a circular stop disc 192 controls the angle of splay of the pins 181 attached to the pivoting arms 183. The lengths of the pivoting arms 183 is such that their inner ends 193, projects beneath the stop disc 192 and are pressed against it by respective coil compression springs 199 located partially in bores 200 in the bearing member 186. As indicated in Figures 18 and 19 the stop disc 192 has a convexly curved annular face on the side nearest to the pivoting arms 183 so that these do not ride on sharp edges when being pivoted. The screwthreaded bolt which functions as the adjusting element 191 is inserted through a central open bore in the bearing member 186. An internally threaded nut, formed by the boss 195 of a handwheel 196, is screwed onto the adjusting member 191 and bears on the endface of the bearing member 186 which is distal from the stop disc 192. The operating device 190 can be actuated and the entire changeover device 180 with and without collet chuck nose part 171 can be readily handled by means of a rim 197 of the handwheel 196.

A wing nut of a tommybar nut or a nut with a crank can be provided in place of the handwheel 196 if the bearing member 186 is provided with handles. To prevent the adjusting part co-rotating with the handwheel, due to unfavourable frictional conditions in the screwthread between the adjusting part 191 and the handwheel 196, it is convenient to provide the unthreaded shank part 198 of the adjusting element 191 with guide surfaces, for example to construct it as a square cross-section member, and to form the opening in the bearing member 186 which receives it correspondingly, as indicated in Figure 20. Irrespective of the gravitational force acting on the coupling elements 181 associated with the pivoting arms 183 said coupling elements are always equally aligned with respect to each other to facilitate coupling to a collet chuck nose part.

To exchange a collet chuck nose part 171 the changeover device 190 in the adjusting state shown in Figure 18, i.e. with the coupling elements 181 aligned parallel with the longitudinal axis 184 of the collet chuck 170, is mounted on the collet chuck nose part 171 so that the coupling elements 181 engage entirely within the bores 179 of the collet chuck nose part. Rotation of the handwheel 196 causes the adjusting element 191 to be adjusted to the right as can be seen by reference to Figure 19. The stop disc 192 of the adjusting element 191 will thrust the ends 193 of the pivoting arms 183, which bear on the adjusting element, towards the bearing member 186. As a result of the pivoting motion of the pivoting arms 183 the coupling elements 181 are also pivoted so that their ends 182, which are situated farthest away from the hinge joints 185, approach the longitudinal axis 184 of the collet chuck 170 on an

arcuate path. The approach motion is continued until the coupling part 177 of the collet chuck nose part 171 (see Figure 21) is released, i.e. a collar 202 situated behind the circumferential groove 201 is positioned within the coupling ring 203 in the radial direction. The changeover device 180 together with the collet chuck nose part 171 can then be withdrawn to the front from the collet chuck tube part 172. Conversely, a collet chuck nose part to be inserted is gripped by the changeover device in the same manner outside the lathe and brought into its stressed state as illustrated in Figure 19. Thereafter it can be inserted into the collet chuck tube part 172 and by operating the changeover device can be coupled to the collet chuck tube part 172 by moving the changeover device 180 reversely to that described above.

In the embodiment shown in Figures 18 and 19 the engagement of the segmented collar 202 behind the ring 203 provides retaining means which are radially releasable, as shown in Figure 19, by application of the changeover device 180.

CLAIMS

1. A collet chuck comprising a nose part disconnectably attached to a coaxilly arranged tube part by a releasable coupling; the nose part having circumferentially spaced jaws with resilient means provided between them to enable the jaws to move radially independently of one another to bring clamping surfaces of the jaws into contact with a workpiece inserted into the nose part when an externally frusto-conical surface of the nose part is compressed radially inwards; the tube part having a mounting thread for screwing it onto a draw-in device; and, the releasable coupling being formed by co-operating portions of the two parts which transmit torque positively between them and are held in engagement by radially releasable retaining means.

2. A chuck as claimed in claim 1, in which the resilient means comprise elastomeric material between the opposed flank surfaces of the jaws and attached thereto.

3. A chuck as claimed in claim 1 or claim 2, in which the co-operating portions comprise circumferentially distributed projections alternating with recesses on each of the two parts, the projections of one part being accommodated in the recesses of the other part and being held in position by a divided coupling ring forming said retaining means and accommodated in a circumferential groove sections of which are formed in the projections of the two parts.

4. A chuck as claimed in claim 3, in which the coupling ring is divided into at least two arcuate portions which meet one another on opposite sides of the chuck.

5. A chuck as claimed in claim 4, in which the portions of the ring are each hinged at one end of one collet part about an axis extending perpendicular to the plane of the ring.

6. A chuck as claimed in claim 5, in which the portions of the ring are each hinged to the same projection of the collet tube part.

7. A chuck as claimed in claim 5, or claim 6, in which each hinge is formed by a hinge-joint pin extending through registering aligned bores formed in the ring portion and two regions of the projection between which the groove passes.

8. A chuck as claimed in claim 7, in which the hinge-joint pins of respective ring portions extend in spaced relationship parallel to the tube part axis, each pin having a neck which receives one diametrically opposite part-cylindrical portion of a locking member held in an opening passing between the two locking pins.

9. A chuck as claimed in any one of claims 3 to 8, including holding means for retaining the ring in the groove.

10. A chuck as claimed in claim 9, in which the ring is divided into separately moving arcuate portions and the holding means comprise interengaging projections and recesses provided at adjacent ends of the ring arcuate portions.

11. A chuck as claimed in claim 9, in which the ring is formed as a resilient circlip and its natural resistance to bending provides said holding means.

12. A chuck as claimed in Claim 9, in which the holding means comprises a position lock having a spring-loaded catch on one of the two collet parts and which is movable between two positions at one of which it engages in a lateral socket in a portion of the ring and at the other position the ring portion is freed for movement in the plane of the ring.

13. A chuck as claimed in claim 12, in which the catch is a spring-loaded ball displaceable along a bore and protruding through an annulus of a collar closing one end of the bore in order to engage in a holding socket in the ring.

14. A chuck as claimed in claim 9, in which the holding means is disposed adjacent a division in the ring and comprises a locking slide pin mounted in one of the parts for endwise movement transverse to the plane of the ring which is apertured to receive the slide pin, the slide pin being movable between two positions at the first of which the ring is freed and at the second of which the slide pin extends through the ring aperture and into an aligned opening in said one part of the opposite side of the aperture.

15. A chuck as claimed in claim 14, including a locking arrangement for the slide pin and which must be turned before the slide ring is freed for movement for its second position to its first position.

16. A chuck as claimed in claim 15, in which the locking arrangement comprises a main recess in which an end-portion of the slide pin is accommodated during its movement between its two positions, said end-portion of the slide pin having a lateral extension ending in cranked terminal portion which projects from the main recess when the pin is in its first position but which, by turning the lateral extension when the pin is in its second position, is self-latching in a

well formed in the collet part at the end of a branch slot linking the recess to the well and which receives the lateral extension so that all parts of the slide pin lie within the outline of the collet part in which it is mounted.

17. A chuck as claimed in claim 16, in which two parallel slide pins for locking respective ends of two ring portions extend into the same recess which is provided on each side with a branch slot leading to a well.

18. A chuck as claimed in claim 14, in which the slide pin has an operating portion lying in a recess in the collet part and formed with a lateral projection inside the recess and which snaps past a stem in the recess during movement of the pin between its two positions.

19. A chuck as claimed in claim 18, in which the recess contains a return bend of a hairpin shaped element providing two slide pins associated with respective end-portions of two ring portions, the return bend having two indented portions directed towards one another from respective slide pins and which are separated by a gap which is less than the width of a stem located in the recess and between the two parallel slide pins.

20. A chuck as claimed in claim 12 or claim 13, in which the holding means are provided on the collet chuck nose part.

21. A chuck as claimed in any one of claims 14 to 19, in which the holding means are provided on the collet tube part.

22. A chuck as claimed in any one of claims 3 to 9 or any one of claims 12 to 21, in which the ring is circumferentially corrugated and the pitch of the corrugations is equal to the pitch of the coupling projections on one of the collet parts.

23. A chuck as claimed in claim 22, in which the height of the corrugations, measured parallel to the ring axis, is at least equal to the maximum elastic deformation of the ring produced by the operational loads for which it is designed to withstand.

24. A chuck as claimed in any one of the preceding claims, in which the co-operating portions of the two collet parts at the coupling have, when viewed in development, a castellated profile.

25. A chuck as claimed in any one of claims 1 to 23, in which the co-operating portions of the two collet parts have, when viewed in development, projections each of T-shape and dimensioned to interfit with one another by the stem of a T-projection passing between the heads of respective opposed T-projections and the head of said T-formation extending between the sides of the stems of said opposed T-projections.

26. A chuck as claimed in any one of the preceding claims, provided with a change-over device equipped with fixtures which can engage with complementary parts of each of the jaws of the collet chuck nose part, a handle on the change-over device being operable to increase the angle between the jaws and the centre line of the collet chuck nose part so that the radially inward movement of the portions of the jaws in the region of coupling occurs to release the retaining means and allows the collet chuck nose part to be released and separated from the collet chuck tube part.

27. A chuck as claimed in claim 26, in which the fixtures comprise dowel pins mounted on a ring of radial levers capable of simultaneous movement to vary together and by the same amount the angle made by the dowel pin axes to the axis of the collet chuck nose part, and said complementary parts of the jaws are respective holes formed in the jaws at their end faces remote from the releasable coupling.

28. A chuck as claimed in claim 27, in which the levers are third order levers pivoted to a plate at their outer ends, and having the dowel pins extending from one side of the levers between the pivotal connection and coiled compression springs disposed between the plate and the other side of the levers, the inner ends of the levers being borne on by a head of a bolt passing centrally through the plate and having screwed onto its other end which projects from the opposite side of the plate to the dowel pins, a threaded boss of a capstan handle which is turnable to alter the inclination of the dowel pins to the axis of symmetry of the change over device.

29. A chuck as claimed in claim 1, arranged and adapted to operate substantially as described with reference to any of the embodiments, or modifications thereof, illustrated in the accompanying drawings.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1979
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.